1.

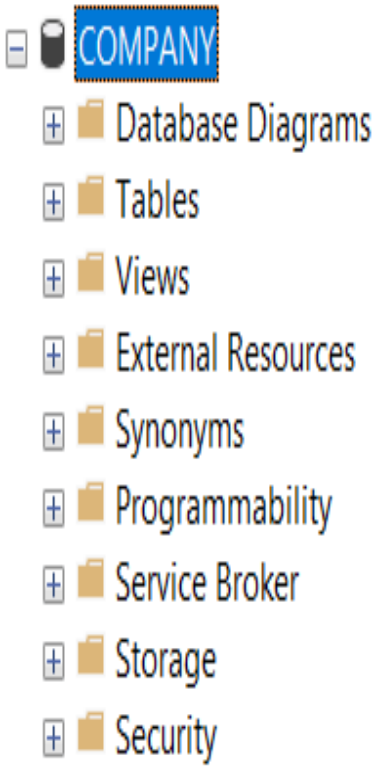
```
CREATE TABLE EMPLOYEE
(Fname VARCHAR(50) NOT NULL,
Minit CHAR,
Lname VARCHAR(50) NOT NULL,
Ssn CHAR(9) NOT NULL,
Bdate DATE,
Address VARCHAR(50),
Sex CHAR,
Salary DECIMAL(10, 2),
Super_ssn CHAR(9),
Dno INT NOT NULL,
PRIMARY KEY(Ssn));
```

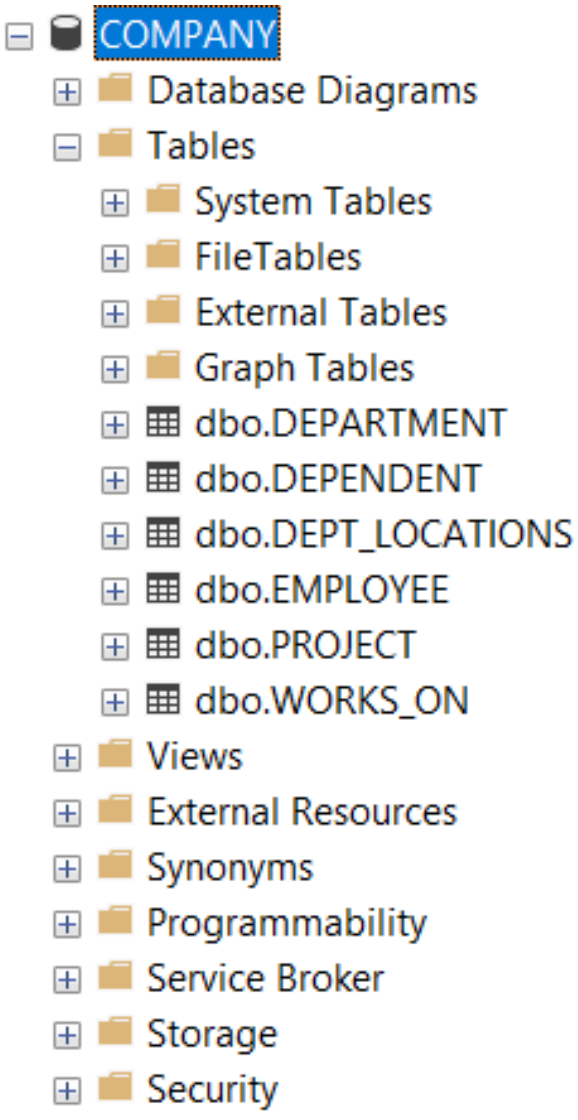
```
CREATE TABLE DEPARTMENT (
Dname varchar(25) NOT NULL,
Dnumber INT NOT NULL,
Mgr_ssn char(9) NOT NULL,
Mgr_start_date date,
PRIMARY KEY(Dnumber),
UNIQUE(Dname),
FOREIGN KEY (Mgr_ssn) REFERENCES EMPLOYEE(Ssn));
```

```
CREATE TABLE DEPT_LOCATIONS (
Dnumber int NOT NULL,
Dlocation varchar(25) NOT NULL,
PRIMARY KEY (Dnumber, Dlocation),
FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber));

CREATE TABLE PROJECT (
Pname VARCHAR(25) NOT NULL,
Pnumber INT NOT NULL,
Plocation varchar(25),
Dnum INT NOT NULL,
PRIMARY KEY(Pnumber),
UNIQUE (Pname),
FOREIGN KEY (Dnum) REFERENCES DEPARTMENT(Dnumber));

CREATE TABLE WORKS_ON (
Essn CHAR(9) NOT NULL,
Pno INT NOT NULL,
Hours DECIMAL(3,1) NOT NULL,
PRIMARY KEY(Essn,Pno),
FOREIGN KEY (Essn) REFERENCES EMPLOYEE(Ssn),
FOREIGN KEY (Pno) REFERENCES PROJECT(Pnumber));

CREATE TABLE DEPENDENT (
Essn CHAR(9) NOT NULL,
Dependent_name varchar(50) NOT NULL,
Sex CHAR,
Bdate DATE,
Relationshop varchar(10),
PRIMARY KEY (Essn, Dependent_name),
FOREIGN KEY (Essn) REFERENCES EMPLOYEE(Ssn));
```

```
INSERT INTO EMPLOYEE values ('John', 'B', 'Smith', '123456789', '1965-01-09', '731
Fondren, Houston, TX', 'M', '30000', '333445555', '5');
INSERT INTO EMPLOYEE values ('Franklin', 'T', 'Wong', '333445555', '1955-12-08', '638
Voss, Houston, TX', 'M', '40000', '888665555', '5');
INSERT INTO EMPLOYEE values ('Alicia', 'J', 'Zelaya', '999887777', '1968-01-19', '3321
Castle, Spring, TX', 'F', '25000', '987654321', '4');
INSERT INTO EMPLOYEE values ('Jennifer', 'S', 'Wallace', '987654321', '1941-06-20', '291
Berry, Bellaire, TX', 'F', '43000', '888665555', '4');
INSERT INTO EMPLOYEE values ('Ramesh', 'K', 'Narayan', '666884444', '1962-09-15', '975
Fire Oak, Humble, TX', 'M', '38000', '333445555', '5');
INSERT INTO EMPLOYEE values ('Joyce', 'A', 'English', '453453453', '1972-07-31', '5631
Rice, Houston, TX', 'F', '25000', '333445555', '5');
INSERT INTO EMPLOYEE values ('Ahmad', 'V', 'Jabbar', '987987987', '1969-03-29', '980
Dallas, Houston, TX', 'M', '25000', '987654321', '4');
INSERT INTO EMPLOYEE values ('James', 'E', 'Borg', '888665555', '1937-11-10', '450 Stone,
Houston, TX', 'M', '55000', NULL,'1');



INSERT INTO DEPARTMENT values ('Research', '5', '333445555', '1988-05-22');
INSERT INTO DEPARTMENT values ('Administration', '4', '987654321', '1995-01-01');
INSERT INTO DEPARTMENT values ('Headquarters', '1', '888665555', '1981-06-19');



INSERT INTO DEPT_LOCATIONS values ('1', 'Houston');
INSERT INTO DEPT_LOCATIONS values ('4', 'Stafford');
INSERT INTO DEPT_LOCATIONS values ('5', 'Bellaire');
INSERT INTO DEPT_LOCATIONS values ('5', 'Sugarland');
INSERT INTO DEPT_LOCATIONS values ('5', 'Houston');



INSERT INTO PROJECT values ('ProductX', '1', 'Bellaire', '5');
INSERT INTO PROJECT values ('ProductY', '2', 'Sugarland', '5');
INSERT INTO PROJECT values ('ProductZ', '3', 'Houston', '5');
INSERT INTO PROJECT values ('Computerization', '10', 'Stafford', '4');
INSERT INTO PROJECT values ('Reorganization', '20', 'Houston', '1');
INSERT INTO PROJECT values ('Newbenefits', '30', 'Stafford', '4');



INSERT INTO WORKS_ON values ('123456789', '1', '32.5');
INSERT INTO WORKS_ON values ('123456789', '2', '7.5');
INSERT INTO WORKS_ON values ('666884444', '3', '40.0');
INSERT INTO WORKS_ON values ('453453453', '1', '20.0');
INSERT INTO WORKS_ON values ('453453453', '2', '20.0');
INSERT INTO WORKS_ON values ('333445555', '2', '10.0');
INSERT INTO WORKS_ON values ('333445555', '3', '10.0');
INSERT INTO WORKS_ON values ('333445555', '10', '10.0');
INSERT INTO WORKS_ON values ('333445555', '20', '10.0');
INSERT INTO WORKS_ON values ('999887777', '30', '30.0');
INSERT INTO WORKS_ON values ('999887777', '10', '10.0');
INSERT INTO WORKS_ON values ('987987987', '10', '35.0');
INSERT INTO WORKS_ON values ('987987987', '30', '5.0');
INSERT INTO WORKS_ON values ('987654321', '30', '20.0');
INSERT INTO WORKS_ON values ('987654321', '20', '15.0');
```

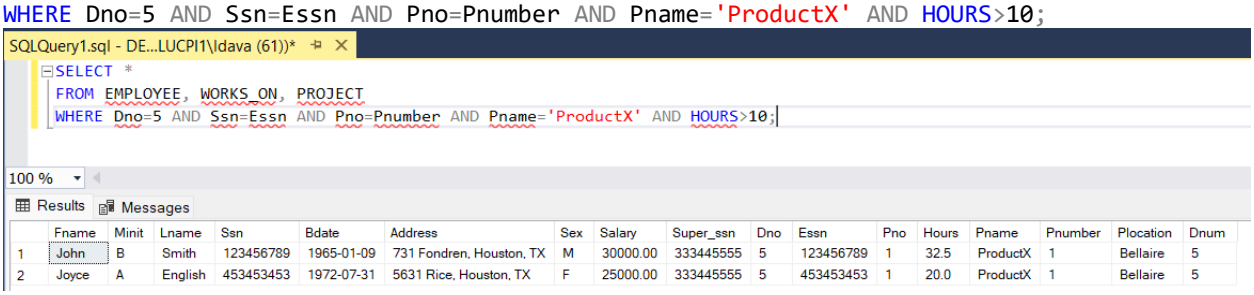
```
INSERT INTO WORKS_ON values ('888665555', '20', NULL);


INSERT INTO DEPENDENT values ('333445555', 'Alice', 'F', '1988-04-05', 'Daughter');
INSERT INTO DEPENDENT values ('333445555', 'Theodore', 'M', '1983-10-25', 'Son');
INSERT INTO DEPENDENT values ('333445555', 'Joy', 'F', '1958-05-03', 'Spouse');
INSERT INTO DEPENDENT values ('987654321', 'Abner', 'M', '1942-02-28', 'Spouse');
INSERT INTO DEPENDENT values ('123456789', 'Michael', 'M', '1988-01-04', 'Son');
INSERT INTO DEPENDENT values ('123456789', 'Alice', 'F', '1988-12-30', 'Daughter');
INSERT INTO DEPENDENT values ('123456789', 'Elizabeth', 'F', '1967-05-05', 'Spouse');
```





a.

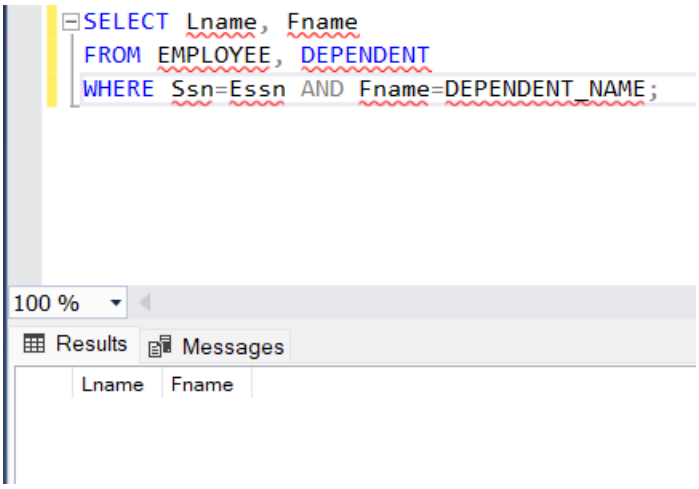
```
SELECT *
FROM EMPLOYEE, WORKS_ON, PROJECT
WHERE Dno=5 AND Ssn=Essn AND Pno=Pnumber AND Pname='ProductX' AND HOURS>10;
```



	Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno	Essn	Pno	Hours	Pname	Pnumber	Plocation	Dnum
1	John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000.00	333445555	5	123456789	1	32.5	ProductX	1	Bellaire	5
2	Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000.00	333445555	5	453453453	1	20.0	ProductX	1	Bellaire	5

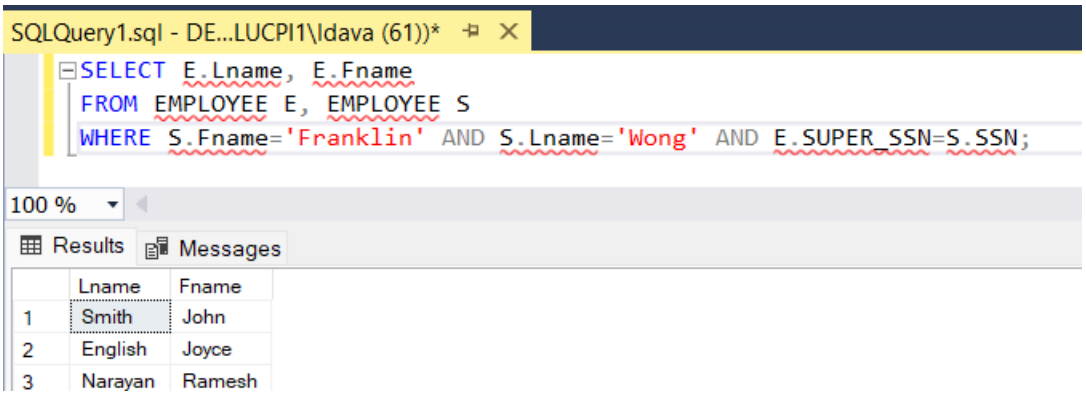
b.

```
SELECT Lname, Fname
FROM EMPLOYEE, DEPENDENT
WHERE Ssn=Essn AND Fname=DEPENDENT_NAME;
```



c.

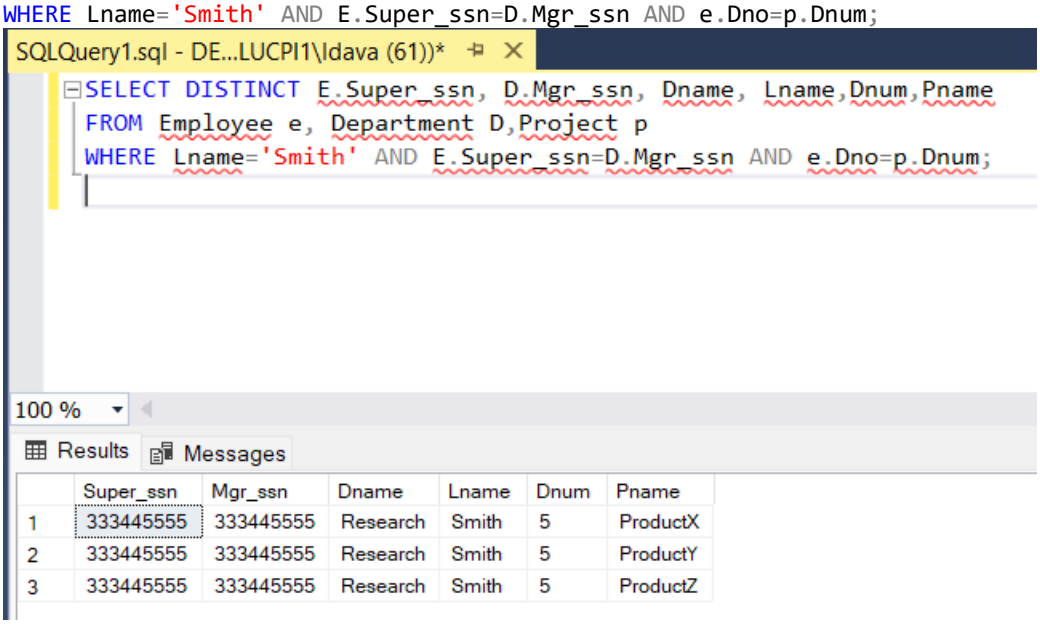
```
SELECT E.Lname, E.Fname
FROM EMPLOYEE E, EMPLOYEE S
WHERE S.Fname='Franklin' AND S.Lname='Wong' AND E.SUPER_SSN=S.SSN;
```



	Lname	Fname
1	Smith	John
2	English	Joyce
3	Narayan	Ramesh

d.

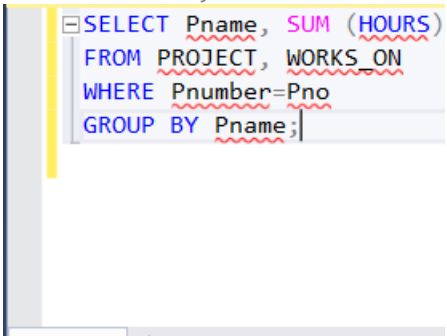
```
SELECT DISTINCT E.Super_ssn, D.Mgr_ssn, Dname, Lname,Dnum,Pname
FROM Employee e, Department D,Project p
WHERE Lname='Smith' AND E.Super_ssn=D.Mgr_ssn AND e.Dno=p.Dnum;
```



	Super_ssn	Mgr_ssn	Dname	Lname	Dnum	Pname
1	333445555	333445555	Research	Smith	5	ProductX
2	333445555	333445555	Research	Smith	5	ProductY
3	333445555	333445555	Research	Smith	5	ProductZ

e.

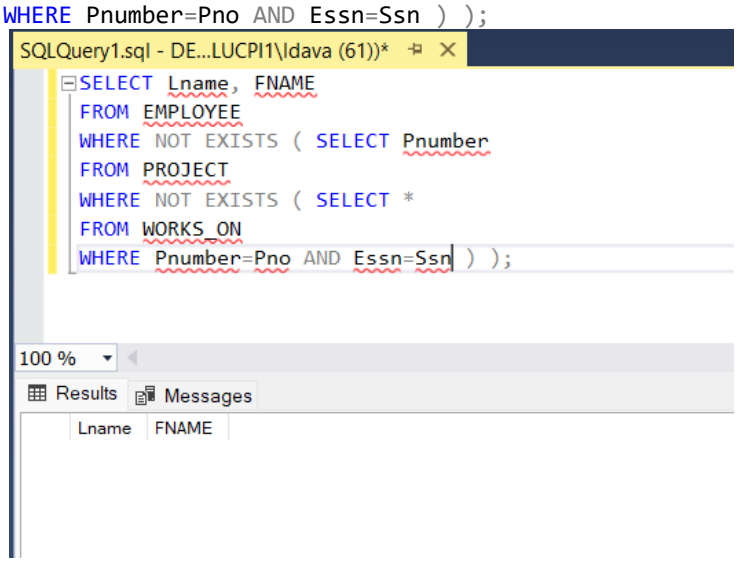
```
SELECT Pname, SUM (HOURS)
FROM PROJECT, WORKS_ON
WHERE Pnumber=Pno
GROUP BY Pname;
```



	Pname	(No column name)
1	Computerization	55.0
2	Newbenefits	55.0
3	ProductX	52.5
4	ProductY	37.5
5	ProductZ	50.0
6	Reorganization	25.0

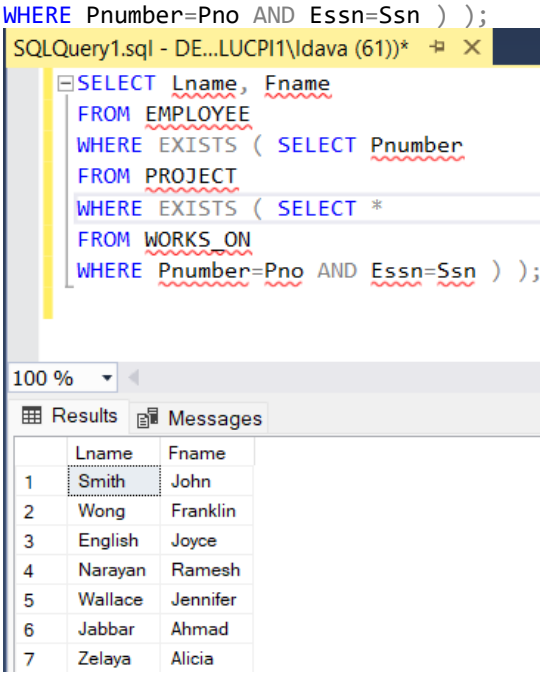
f.

```
SELECT Lname, Fname
FROM EMPLOYEE
WHERE NOT EXISTS ( SELECT Pnumber
FROM PROJECT
WHERE NOT EXISTS ( SELECT *
FROM WORKS_ON
WHERE Pnumber=Pno AND Essn=Ssn ) );
```



g.

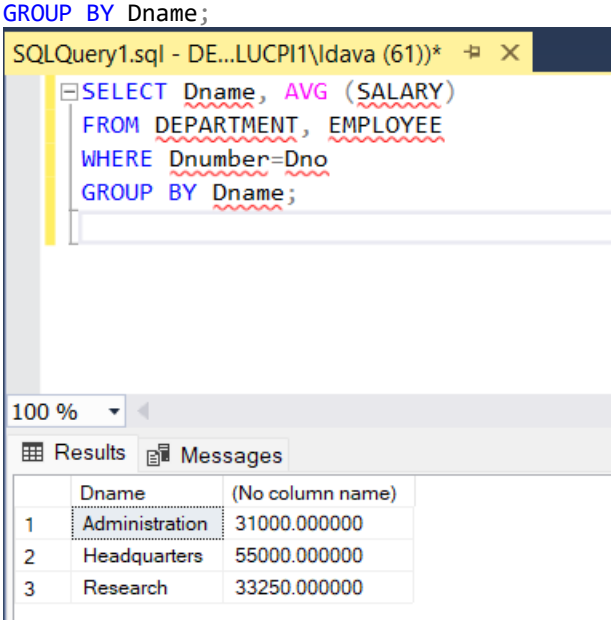
```
SELECT Lname, Fname
FROM EMPLOYEE
WHERE EXISTS ( SELECT Pnumber
FROM PROJECT
WHERE EXISTS ( SELECT *
FROM WORKS_ON
WHERE Pnumber=Pno AND Essn=Ssn ) );
```



	Lname	Fname
1	Smith	John
2	Wong	Franklin
3	English	Joyce
4	Narayan	Ramesh
5	Wallace	Jennifer
6	Jabbar	Ahmad
7	Zelaya	Alicia

h.

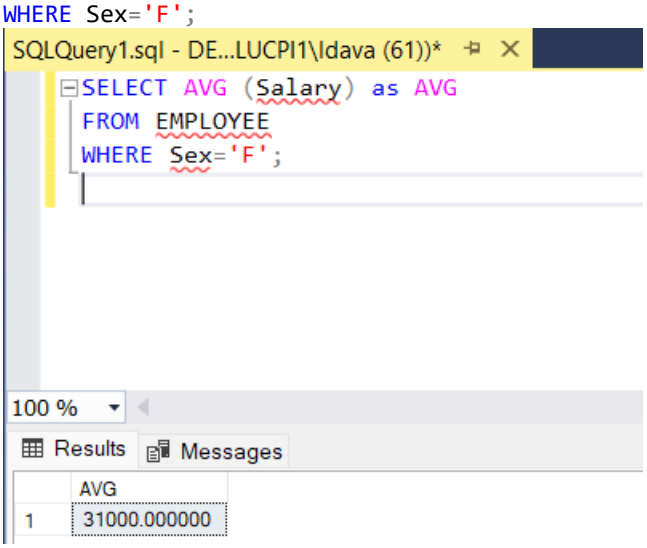
```
SELECT Dname, AVG (SALARY)
FROM DEPARTMENT, EMPLOYEE
WHERE Dnumber=Dno
GROUP BY Dname;
```



	Dname	(No column name)
1	Administration	31000.000000
2	Headquarters	55000.000000
3	Research	33250.000000

i.

```
SELECT AVG (Salary) as AVG
FROM EMPLOYEE
WHERE Sex='F';
```



	AVG
1	31000.000000

3.

a.

```
σ dno = 5 AND ssn = essn AND pno = pnumber AND pname="ProductX" AND hours > 10 (employee × works_on × project)
```

b.

```
π lname, fname
 σ ssn = essn AND fname = dependent_name (employee × dependent)
```

c.

```
π e.lname, e.fname
 σ s.fname= "Franklin" AND s . lname = "Wong" AND e.super_ssn =s.ssn
  (ρ e employee × ρ s employee)
```

d.

```
δ
 π e . super_ssn, d . mgr_ssn, dname, lname, dnum, pname
  σ lname = "Smith" AND e . super_ssn = d . mgr_ssn AND e . dno = p . dnum
   (ρ e employee × ρ d department × ρ p project)
```

e.

Relational Algebra | SQL | Group Editor

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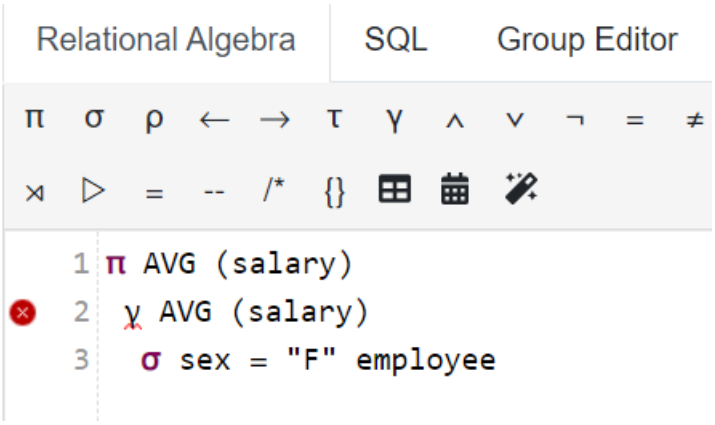
⋊ ▷ = -- /* {}

```
1 γ pname, SUM (hours)
2  σ pnumber = pno (project × works_on)
```

h.

```
γ dname, AVG (salary)
 σ dnumber = dno (department × employee)
```

i.


Relational Algebra
SQL
Group Editor
π σ ρ ← → τ γ ∧ ∨ ¬ = ≠
⋈ ▷ = -- /* {}
1 π AVG (salary)
2 γ AVG (salary)
3 σ sex = "F" employee